

# Course Introduction: Overview of Water Supply Forecasting Practices

Kevin Werner, CBRFC

# Outline

- Overview of the day
- Introductions
- Overview of forecast process

# Course Goals

- Description of current and future water supply forecast techniques
- Interactive discussions on decision making under uncertainty
- Multi-directional discussions are important to improve forecast and decision making paradigms

# Course Agenda

## **SHORT COURSE**

### **Hydrologic Prediction and Verification Techniques with a Focus on Water Supply**

#### **ORGANIZERS**

Marina Timofeyeva, Andy Wood, Kevin Werner, Barbara Brown, Thomas Adams, David Bright

#### **AMS HYDROLOGY COMMITTEE, SPONSOR**

Bart Nijssen, Chair

#### **AMS COMMITTEE ON PROBABILITY AND STATISTICS, SPONSOR**

Richard W. Katz, Chair

#### **FINANCIAL SUPPORT PROVIDED BY**

NOAA/NWS Office of Hydrologic Development  
NOAA/NWS Western Region Headquarters

#### **SUNDAY, 23 JANUARY 2011**

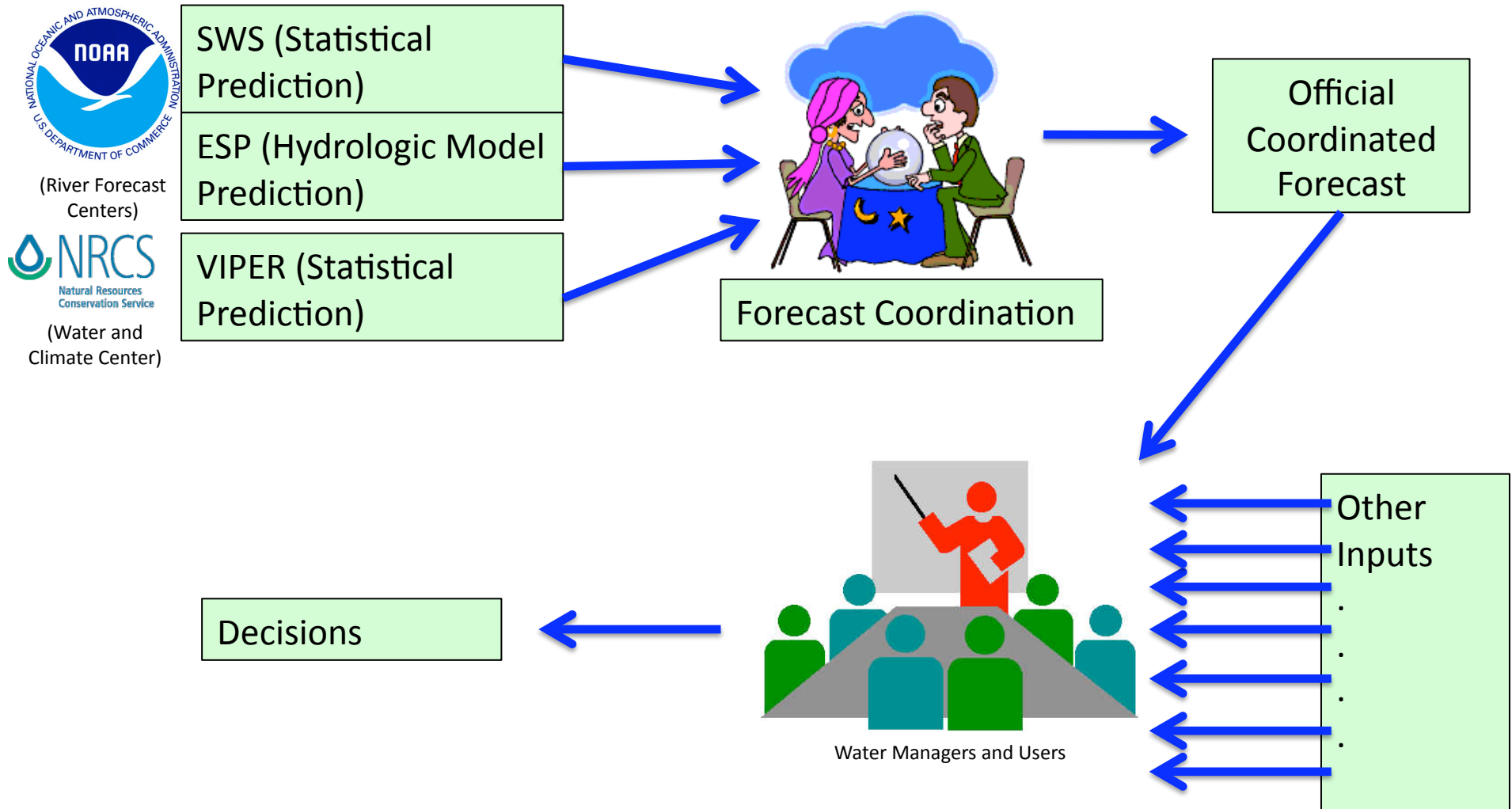
7:30 - 8:15	REGISTRATION
8:15 – 8:45	COURSE INTRODUCTION: OVERVIEW OF HYDROLOGIC FORECASTING PRACTICES AND WATER SUPPLY – Kevin Werner , NOAA/NWS Colorado Basin River Forecast Center (CBRFC), Salt Lake City, UT [ <a href="#">pptx</a>   <a href="#">pdf</a> ]
8:45 – 10:00	STATISTICAL FORECASTING FOR HYDROLOGIC PREDICTION – Gus Goodbody and David Garen, USDA/NRCS National Water and Climate Center, Portland, OR [ <a href="#">pptx</a>   <a href="#">pdf</a> ]
10:00 – 10:15	BREAK
10:15– 11:00	STATISTICAL FORECASTING IN HYDROLOGIC PREDICTIONS, continued – Gus Goodbody and David Garen, USDA/NRCS National Water and Climate Center, Portland, OR
11:00 – 11:30	ENSEMBLE STREAMFLOW PREDICTION (ESP) INTRODUCTION – Kevin Berghoff, NOAA/NWS Northwest River Forecast Center (NWRFC), Portland, OR [ <a href="#">pptx</a>   <a href="#">pdf</a> ]
11:30 – 12:00	ESP: VERIFICATION AND RECENT ADVANCES – Julie Demargne and James Brown, NOAA/NWS Office of Hydrologic Development, Silver Spring, MD [ <a href="#">pptx</a>   <a href="#">pdf</a> ]
12:00 – 1:00	LUNCH (provided)
1:00 – 2:30	HANDS ON ESP EXERCISES – ALL, led by CBRFC and NWRFC [ <a href="#">pdf</a> ]
2:30 – 3:00	INTRO TO RISK BASED DECISION-MAKING FOR WATER SUPPLY: BPA CASE STUDIES – Travis Togo, BPA [ <a href="#">pptx</a>   <a href="#">pdf</a> ]
3:00 – 3:15	BREAK
3:15 – 4:15	SCENARIO EXERCISES FOR RISK BASED DECISION MAKING – ALL, led by Kristen Averty, WWA and Kevin Werner, CBRFC
4:15 – 5:00	WESTERN WATER SUPPLY FORECASTING AND CLIMATE CHANGE – Levi Brekke, Bureau of Reclamation Technical Service Center, Denver, CO [ <a href="#">pptx</a>   <a href="#">pdf</a> ]
5:00	ADJOURN

Course materials: [www.cbrfc.noaa.gov/shortcourse/agenda.htm](http://www.cbrfc.noaa.gov/shortcourse/agenda.htm)

# Introductions

- Name
- What you do
- What you want from this course

# Water Supply Forecast Overview



# Forecast Methods

## ➤ Statistical Forecasting

- Statistical Regression Equations
- Primary NOAA/RFC forecast method from 1940's to mid 1990's.
- Primary NRCS/NWCC forecast method
- Historical Relationships between flow, snow, & precipitation (1971-2000+)
- Tied to a fixed runoff period (inflexible)

## ➤ Ensemble Simulation Model Forecasting

- A component of a continuous conceptual model (NWSRFS)
- Continuous *real time* inputs (temperature, precipitation, forecasts)
- Accounts for soil moisture states (SAC-SMA) - drives runoff efficiency
- Builds and melts snowpack (Snow-17) – output feeds SAC-SMA
- Flexible run date, forecast period, forecast parameters.
- Evolving toward ESP as primary forecast tool at NOAA/RFCs

GBYC2 QCMPAZZ P Apr-Jul (COLORADO - LAKE GRANBY, GRANBY, NR) JR2: 0.360 # yrs: 30  
 AVG: 225.000 YTRANS: none

## LAKE IRENE LKIC2/SWIRMZZ

Apr 25.30Z 98% \* 2,623 = 66.36

## PHANTOM VALLEY PHTC2/SWIRMZZ

Apr 9.90Z 107% \* 4,481 = 44.36

## STILLWATER CREEK SCSC2/SWIRMZZ

Apr 6.90Z 88% \* 1,886 = 13.01

## GRAND LAKE 1NW GLKC2/PPMRZZZ (Nov - Mar):

Nov 1.05V 77%

Dec 2.10E 133%

Jan 2.37V 130%

Feb 0.92V 61%

Mar 0.74V 49%

7.18 92% \* 5,238 = 37.61

60,493 + 161.35 = 221.84 ( 99%)

GBYC2 QCMPAZZ a Apr-Jul (COLORADO - LAKE GRANBY, GRANBY, NR) JR2: 0.479 # yrs: 30  
 AVG: 225.000 YTRANS: none

## LAKE IRENE LKIC2/SWIRMZZ

Apr 25.30Z 98% \* 1,825 = 46.17

## PHANTOM VALLEY PHTC2/SWIRMZZ

Apr 9.90Z 107% \* 2,837 = 28.09

## STILLWATER CREEK SCSC2/SWIRMZZ

Apr 6.90Z 88% \* 2,468 = 17.03

## GRAND LAKE 1NW GLKC2/PPMRZZZ (Nov - Mar):

Nov 1.05V 77%

Dec 2.10E 133%

Jan 2.37V 130%

Feb 0.92V 61%

Mar 0.74V 49%

7.18 92% \* 5,552 = 39.86

COLORADO - LAKE GRANBY, GRANBY, NR GBYC2/QCMPAZZ

GBYC2 QCMPAZZ\_0710

Coordinated

Model Computed

Comp. w/ Coord.

NWS Preferred.

Other Agency

R. Max 275.00 122% 288.04 128% 291.20 129% 0.00 0%

**Most Prob. 225.00 100% 221.84 99% 225.00 100% 220.00 98%**

R. Min 178.00 79% 155.64 69% 158.80 71% 0.00 0%

Input Specification

Eqn Output/Fcst Input

Fcst Point Stats

Eqn Stats

Fcst Performance (Oper)

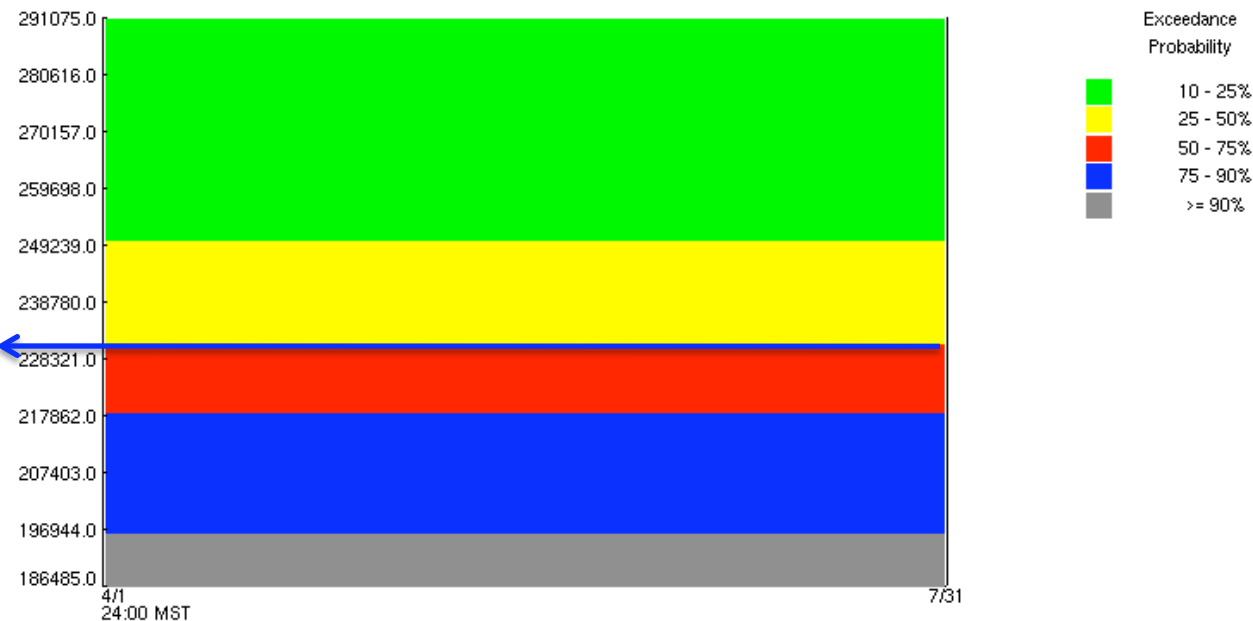
Fcst Performance (Calib)

Log



Forecast Window Chances of Exceeding River Levels on the GRANBY RES INFLOW  
Latitude: 40.2 Longitude: 105.9  
Forecast for the period 4/1/2009 - 7/31/2009  
This is a conditional simulation based on the current conditions as of 3/31/2009

Ensemble 50%  
exceedance  
Forecast:  
**230 kac-ft**



#### FREQUENCY SETTINGS

Exceedance Probability  
Interval Begin Date

Analysis Start Date: 4-1-2009

4 1 2009

Analysis End Date: 8-1-2009



Probability Dist

◆ Empirical

◆ Normal

◆ Log Normal

◆ Wakeby

◆ Weibull

Exceedance Probability Levels (descending)

◆ Default ◆ Manual

1: 0.900 2: 0.750 3: 0.500 4: 0.250 5: 0.100

6: 7: 8: 9: 10:

Flood Levels (ascending)

◆ Default ◆ Manual

1: 999.0 2: 999.0

Apply

Accumulation Settings

# Forecast Coordination

- Forecasts are coordinated with NRCS on a monthly basis. Forecasters at each agency compare forecasts, analyze differences, and come up with a official, coordinated forecast.

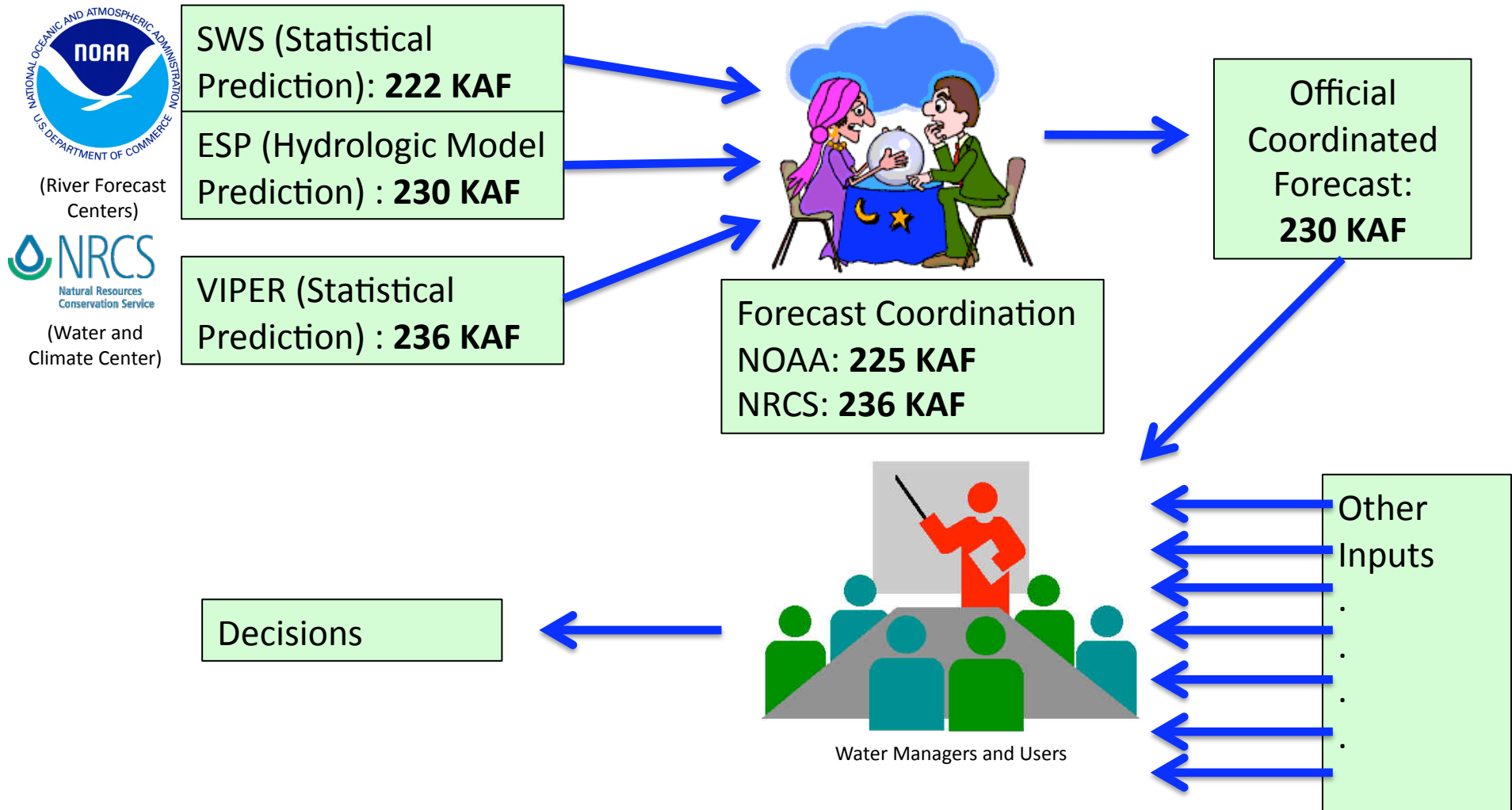


NRCS Preferred  
Forecast:  
**235 kac-ft**

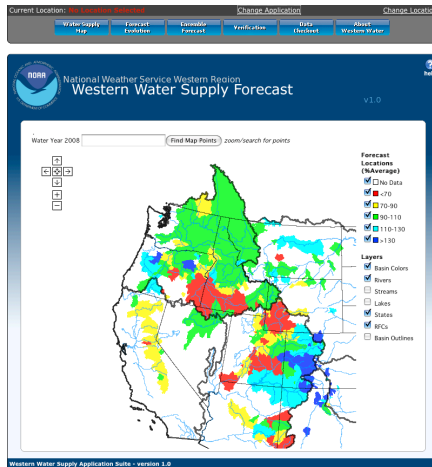
Coordinated  
Forecast:  
**230 kac-ft**

NOAA Preferred  
Forecast:  
**225 kac-ft**

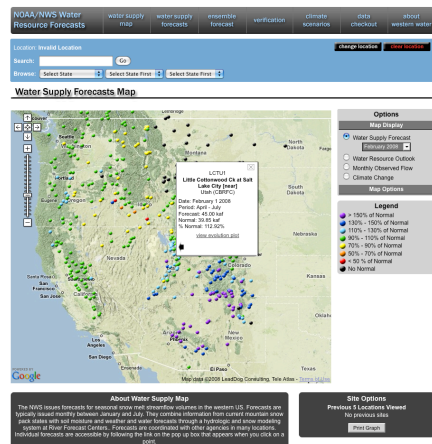
# Water Supply Forecast Overview



# NWS Western Water Supply / Water Resources Outlook



2008 (version 2)



2009 (version 3)

National Weather Service  
**National Water Resources Outlook**

[Home](#)
[Maps](#)
[Points](#)
[Help](#)

[Welcome](#)
[Search for a Point](#)
[About Website](#)

## Welcome to the National Water Resources Outlook

**Notice! This is an Experimental Product.**

Water is an important resource for agriculture, industry, cities, and people all across America. The National Weather Service forecasts streamflow for many rivers around the country to support decision making related to water management. In times of excess, flooding can be planned for or mitigated based on forecasts. In times of scarcity, water can be managed to maximize its value based on forecasts. This site provides access to river forecasts and a variety of visualization tools. Suggestions and comments on this website and NWS water resources forecast services are always welcome.

### Currently Participating River Forecast Centers:

Alaska/Pacific RFC	Arkansas-Red Basin RFC	California-Nevada RFC
Colorado Basin RFC	Lower Mississippi RFC	Middle Atlantic RFC
Missouri River Basin RFC	North-Central RFC	Northeast RFC
Northwest RFC	Ohio RFC	Southeast RFC
		West Gulf RFC

### Three Ways to Get Started:

#### Hydrologic Point Information



Search by River, Location, or Handbook-Five ID

#### National Water Resources Map

Click map above for full, interactive version

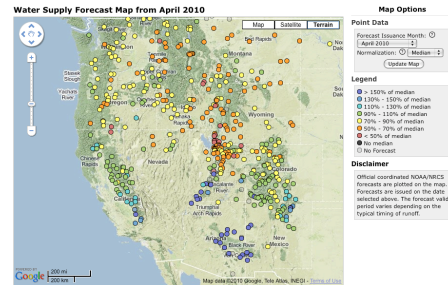
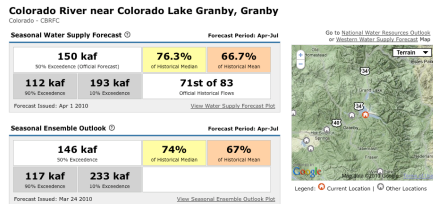
#### Western US Water Supply Map

Click map above for full, interactive version

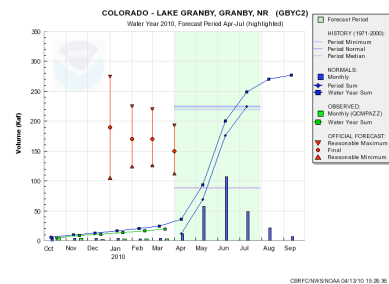
2010 (version 4): [wateroutlook.nwrffc.noaa.gov](http://wateroutlook.nwrffc.noaa.gov)

# Water Supply Forecasts in Western USA

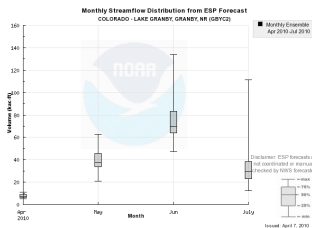
Map



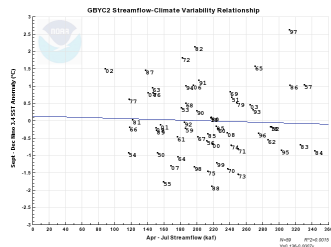
Forecast Overview



Ensemble Forecast – display tool for monthly ESP forecasts



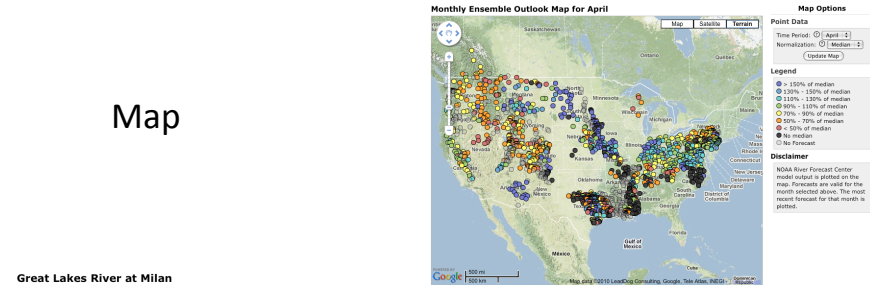
Verification – Many, many verification plots and graphics



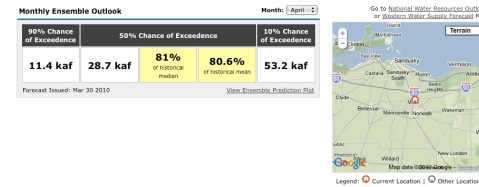
Climate variability – Streamflow / climate index relationship plot

# National Water Resources Outlook

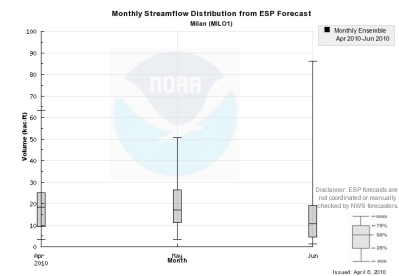
Map



Great Lakes River at Milan

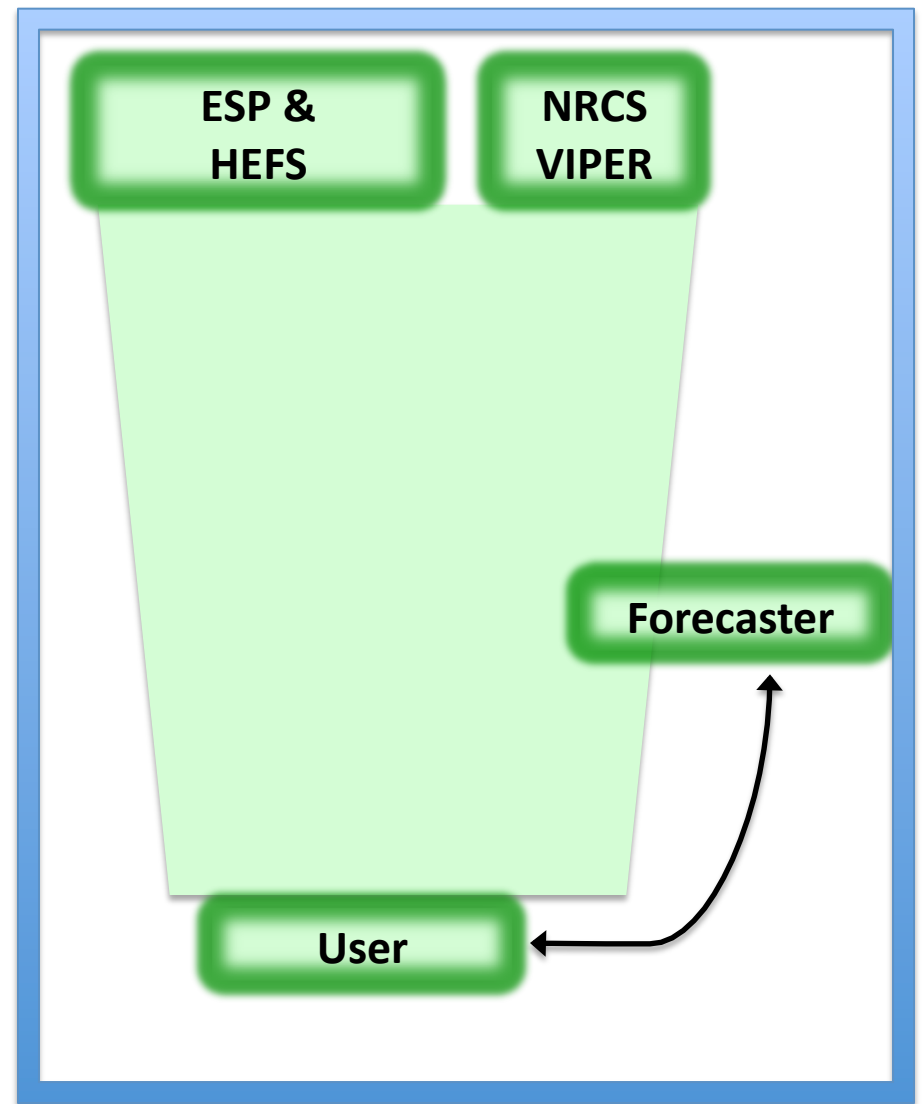
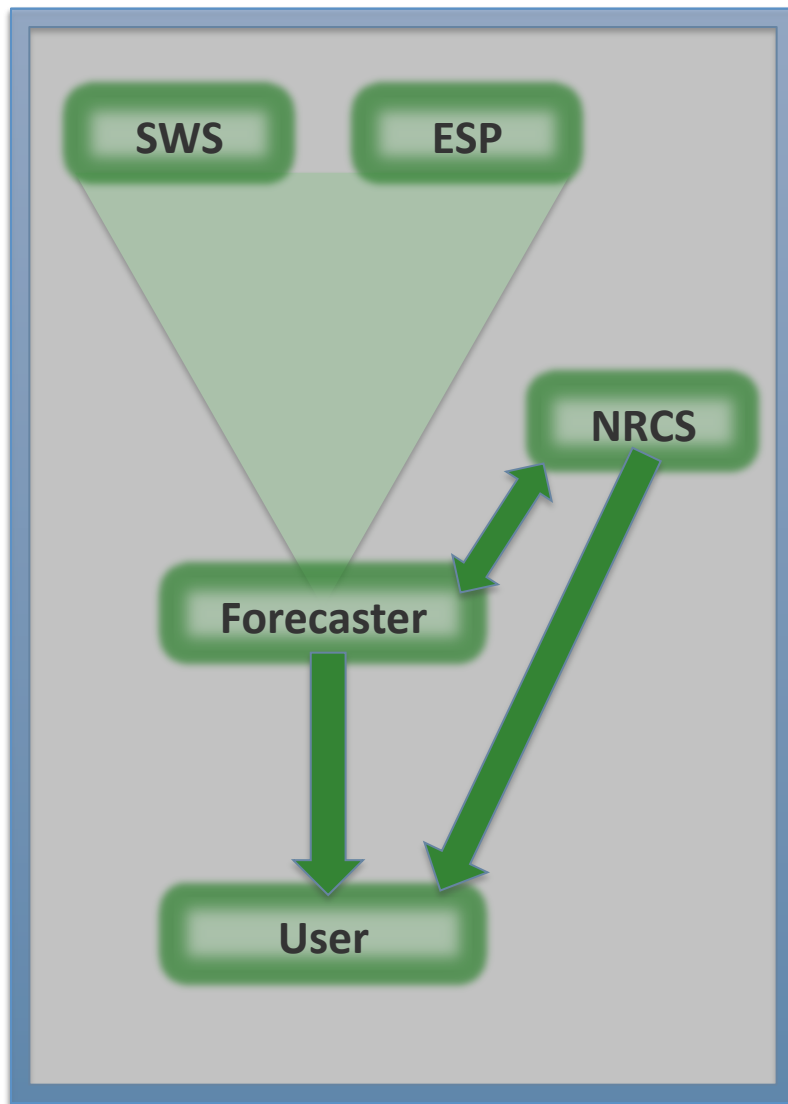


Forecast Overview

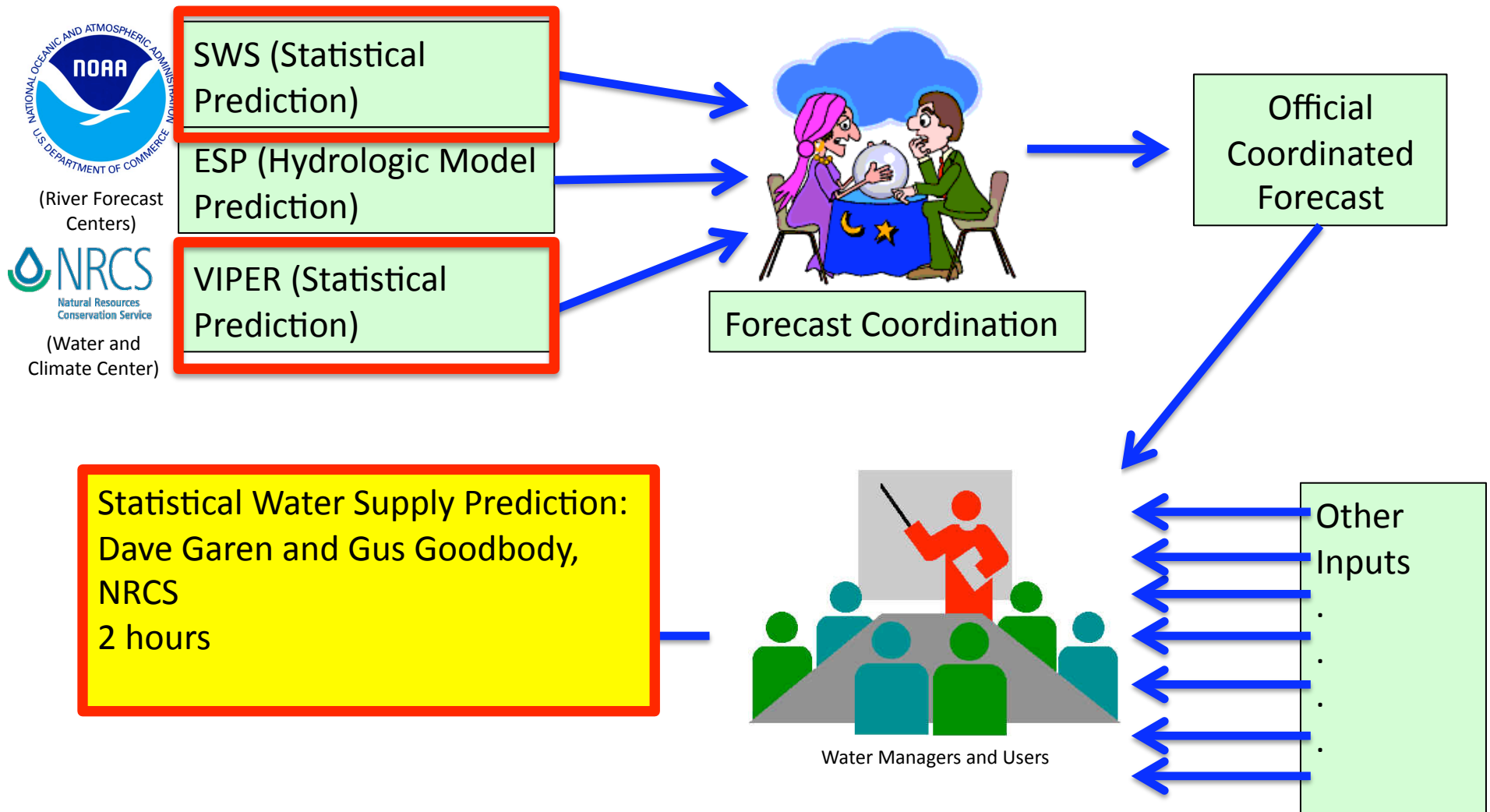


Ensemble Forecast – display tool for monthly ESP forecasts

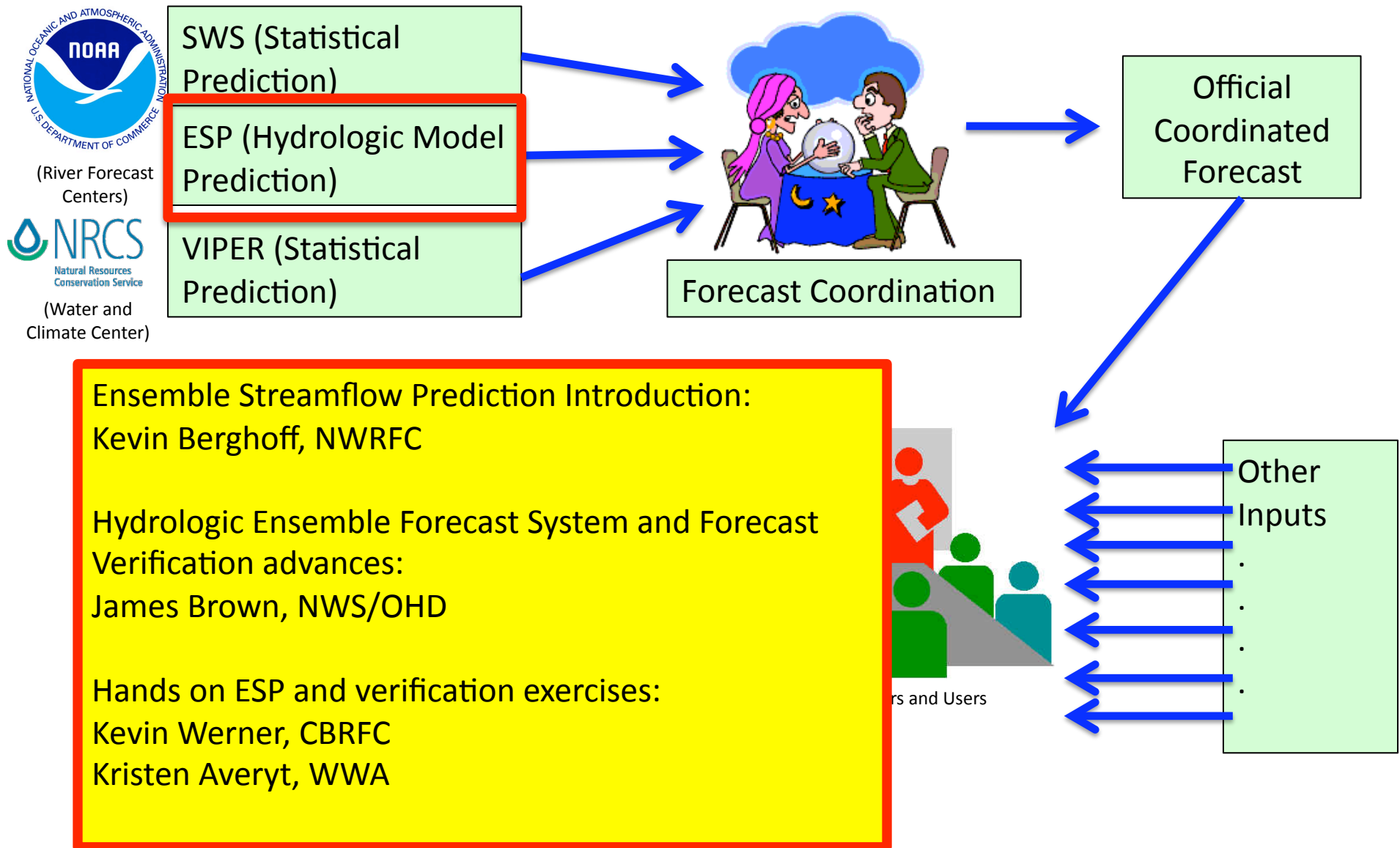
# New Paradigms?



# Today's Short Course



# Today's Short Course





# Today's Short Course

Intro to Risk Based Decision Making:

BPA Case Study

Travis Togo, BPA

Scenario Exercises for Risk Based Decision Making

Kevin Werner, CBRFC

Kristen Averyt, WWA



Coordination

Official  
Coordinated  
Forecast

Decisions



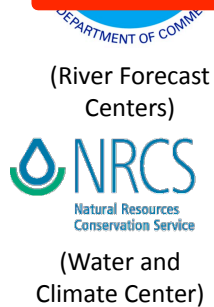
Water Managers and Users

Other  
Inputs

•  
•  
•  
•  
•

# Today's Short Course

Water Supply Forecasting and Climate Change  
Levi Brekke, USBR



ESP (Hydrologic Model Prediction)

VIPER (Statistical Prediction)



Forecast Coordination

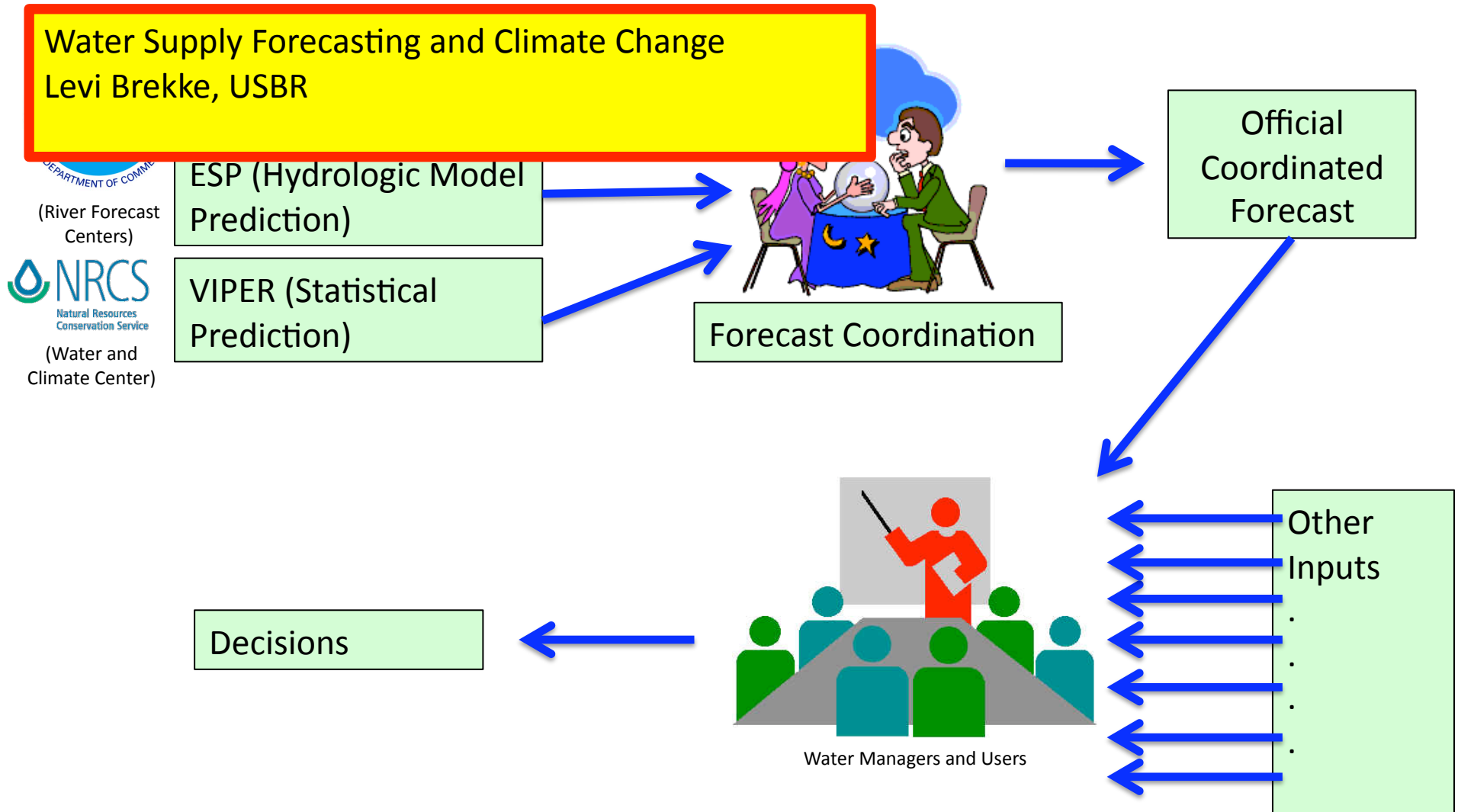
Official Coordinated Forecast

Decisions



Water Managers and Users

Other Inputs



# Course Goals

- Description of current and future water supply forecast techniques
- Interactive discussions on decision making under uncertainty
- Multi-directional discussions are important to improve forecast and decision making paradigms

Questions?